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# METHOD AND SYSTEM FOR PROVIDING A SCREEN SAVER IN A MOBILE ELECTRONIC DEVICE

## FIELD OF THE INVENTION

**[0001]** The present invention relates generally to mobile electronic devices. More particularly, the present invention relates to a method and system for providing a screen saver in a mobile electronic device.

## BACKGROUND OF THE INVENTION

**[0002]** Cathode Ray Tube (CRT) displays suffer from an effect called burn-in. If the same image is left on the CRT for an extended period of time, the phosphor being addressed ages faster than the phosphor not being addressed. The effect of this burn-in is apparent when the CRT is no longer powered, yet an image is still visible. Screen savers or timeouts are generally used to prevent burn-in. Newer display technology such as Organic Light Emitting Diodes (OLEDs) have a similar problem. In the case of OLED panels, or displays, the luminance of the panel decreases over the life of the panel, which is significantly shorter than other display technologies. Another problem with OLED panels is that the life of each primary colour is significantly different. Over time, compensation for the different aging rates of the primary colours is required. Yet another concern with OLED panels is their large power consumption.

**[0003]** Traditional screen savers address these problems, but place a burden on the processor executing the software for the screen saver. Another drawback of the traditional software implementation of a screen saver is the higher on time of the processor, which affects the life of the battery powering the mobile electronic device.

## SUMMARY OF THE INVENTION

**[0004]** According to an aspect of the invention, a system for providing a screen saver for a display panel in a mobile electronic device comprises memory for storing a screen saver image, display controlling means configured to retrieve said screen saver image from said memory and to transmit said screen saver image to said display panel during a screen saver mode, and screen saver controlling means for sensing activity by a CPU interface, for switching operation of said display panel from an operating mode to the

screen saver mode after a predetermined time period of inactivity by the CPU interface, and for controlling primary colours of said display panel to balance life of said primary colours of said display panel.

**[0005]** In accordance with another aspect of the invention, a method of providing a screen saver for a display panel in a mobile electronic device comprises the steps of sensing a time period of inactivity, transmitting a signal to a display controller indicating said sensing of said time period of inactivity, retrieving a screen saver image from memory, determining a display location of said screen saver image on said display panel, displaying said screen saver image on said display panel at said display location, monitoring use of display panel primary colours, and disabling said primary colours such that colours are preserved.

**[0006]** Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0007]** Embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

Figure 1 is a block diagram of an Organic Light Emitting Diode (OLED) driver;

Figure 2 is a block diagram of a screen saver controller; and

Figure 3 is a flow diagram of a method of providing a screen saver for a mobile electronic device.

## DETAILED DESCRIPTION

**[0008]** Generally, a method and system for providing a screen saver in a mobile electronic device are described. The screen saver is implemented via hardware within the mobile electronic device so that there is less burden on a device processor and the life of a battery or other limited power supply typically used in such devices may be extended. Furthermore, in one embodiment, the screen saver provides a colour aging control to preserve the colours of the mobile electronic device panel, or display.

**[0009]** Turning to Figure 1, a diagram illustrating a single integrated circuit (IC) implementation of an Organic Light Emitting Diode (OLED) driver is shown. The driver **10** is connected to a host central processing unit (CPU) **12** via a CPU interface **14**. The CPU interface **14** is connected to a display random access memory (RAM) **16**, a screen saver RAM **18**, a display controller **20**, a screen saver controller **22** and a DC-DC converter **24** which, in turn, is connected to a power source **25**, generally in the form of a battery. The interface **14** also includes an oscillator **36** to provide timing for the driver **10**.

**[0010]** The display RAM **16**, the screen saver RAM **18** and the screen saver controller **22** are connected to a multiplexer (MUX) **26** which is connected to the display controller **20**. The display controller **20** is connected to a common driver **28**, a segment driver **30** and a current reference/digital-to-analog converter (DAC) **32**. The combination of the display controller **20**, the common driver **28** and the segment driver **30** may be seen as display controlling means for controlling the screen saver. The screen saver controller **22** is also connected to the display controller **20** and the current reference/DAC **32** while the current reference/DAC **32** is connected to the segment driver **30**. Both the common driver **28** and the segment driver **30** are connected to an Organic Light Emitting Diode (OLED) panel **34**.

**[0011]** The CPU interface **14** provides an interface between the driver **10** and the host CPU **12** and defines the timing of generic interface signals such as READ, WRITE, CHIP SELECT, ADDRESS LINE(S), DATA LINES, and RESET. The display RAM **16** is preferably SRAM and is used to store an image which is displayed on the OLED panel **34** during an operating mode. In operation, the CPU interface **14** loads the display RAM **16** based on data received from the host CPU **12**. The screen saver RAM **18** is functionally similar to the display RAM **16** but has limited memory to store a screen saver image from the host CPU **12**. For example, the screen saver RAM **18** may only hold data for a 20 x 20 pixel area even though the pixel area of the panel may be a 220 x 176 pixel area.

**[0012]** The MUX **26** is a switch that selects the source of the image data to be displayed on the OLED panel **34**. Therefore, in the operating mode, the MUX **26** provides a connection between the display RAM **16** and the display controller **20** for image

retrieval while in a screen saver mode, the MUX **26** provides a connection between the screen saver RAM **18** and the display controller **20** for image retrieval.

**[0013]** The display controller **20** reads the display image data from the display RAM **16** or the screen saver RAM **18** (depending on its connection via the MUX **26**) one row at a time and displays the data and provides the timing for the row of image data to be displayed on the OLED panel **34**. The display controller **20** then retrieves the next row of image data stored in the display RAM **16** or screen save RAM **18**, depending on which mode the OLED panel **34** is in. This process is repeated several times per second until the entire image is displayed on the panel **34**. The display controller **20** also defines where the display image data from the display RAM **16** or screen saver RAM **18** is mapped onto the OLED panel **34**. For example, the host CPU **12** may transmit a command to the display controller **20** to only display the first fifty lines of image data and leave the rest of the panel **34** blank, or black.

**[0014]** The screen saver controller **22** is used to control the screen saver so that the host CPU **12** does not have as much of a burden. The screen saver controller **22** also controls the MUX **26** as will be described below with respect to Figure 2 which is a schematic diagram of the screen saver controller **22**.

**[0015]** The common driver **28** sends pulses to indicate to the OLED panel **34** the address to which the segment driver **30** is currently sending the image data. Furthermore, the segment driver **30** converts the digital data from the display RAM **16** or screen saver RAM **18** to a current level required to drive the OLED panel **34** at a defined level (pixel luminance). The display RAM **16**, via the display controller **20,** defines this pixel luminance level and transmits this level to the current reference/DAC **32**. The current reference/DAC **32** typically includes a DAC for each of red, green, and blue for a colour display. The DC-DC converter **24** converts the power supply voltage **25,** typically 3 V, to a level required by the OLED panel **34**.

**[0016]** Turning to Figure 2, a schematic block diagram of the screen saver controller **22** is shown. The screen saver controller **22** comprises a set of RGB timers **35** seen as a RED timer comprising a RED preset **36** and a RED down counter **38**, a GREEN timer comprising a GREEN preset **40** and a GREEN down counter **42** and a BLUE timer comprising a BLUE preset **44** and a BLUE down counter **45**. The screen saver controller

**22** also includes a screen saver timer comprising a screen saver down counter **46** and a move icon timer comprising a move icon down counter **48**, along with various AND and OR gates. The move icon down counter **48** is also connected to a command generator **53** which is connected to the display controller **20**. The move icon down counter **48** provides a timer for determining when the location of the screen saver image is to change.

**[0017]** Inputs to the screen saver controller **22** include a clock source **50** originating from the oscillator **36** in the CPU interface **14** and inputs **70, 72** and **90** from the CPU interface **14**.

**[0018]** The command generator **53** generates and transmits two types of commands for the display controller **20**. These two commands are image size and start address (image location). The generated start address of the image display is randomly changed each time the move icon down counter **48** reaches zero so that the screen saver image is constantly moving on the OLED panel **34** in order to preserve the primary colours. The image size that is generated and transmitted by the command generator **53** is based on the size of the screen saver RAM **18** or may be determined to be a smaller size by the command generator **53**. In a preferred embodiment, the image size for the screen saver is a 20 x 20 pixel area.

**[0019]** Each of the RGB timers is used to control one of the primary colours of the OLED panel **34**, to compensate for differential aging of the colours, and is loaded based on values received from the host CPU **12** via the CPU interface **14**. Each of the down counters includes a load input **54**, an enable input **56**, a zero output **58** and a clock input **60**. The clock input **60** of each down counter **38**, **42**, and **45** receives its input from the clock source **50**.

**[0020]** The enable input **56a** of the RED down counter **38** receives the input **70** from the CPU interface **14** while the zero output **58a** of the RED down counter **38** is connected to the enable input **56b** and the load input **54b** of the GREEN down counter **42**. The zero output **58b** of the GREEN down counter **42** is connected to the load input **54c** and the enable input **56c** of the BLUE down counter **45**. The load input **54a** of the RED down counter **38** is loaded with the result from the ORing of the zero output **58c** of the BLUE down counter **45** and the zero output **58d** of the screen saver down counter **46**.

**[0021]** The result of ANDing the input **70** from the CPU interface **14**, the zero output **58a** of the RED down counter **38** and the zero output **58d** of the screen saver down counter **46** controls a disable RED DAC signal **62** while the result of ANDing the input **70** from the CPU interface **14**, the zero output **58b** of the GREEN down counter **42** and the zero output **58d** controls a disable GREEN DAC signal **64** and the result of ANDing the input **70** from the CPU interface **14**, the zero output **58c** of the BLUE down counter **45** and the zero output **58d** of the screen saver time out **46** controls a disable BLUE DAC signal **66**. As described above, the current reference/DAC **32** comprises red, green, and blue DACs.

**[0022]** The load input **54d** and the enable input **56d** for the screen saver down counter **46**, along with the enable input **56e** of the move icon down counter **48** receive their input from input **72** transmitted by the CPU interface **14**.

**[0023]** The zero output **58d** of the screen saver down counter **46** is connected to the MUX **26** and the command generator **53**. The zero output **58e** of the move icon down counter **48** is also connected to the command generator **53**.

**[0024]** In operation, the mobile electronic device OLED panel **34** generally is in one of two operating modes. Mode 1 may be defined the operating mode for the panel whereby the user is interacting with the mobile electronic device while mode 2 is the screen saver mode. As will be understood by one skilled in the art, in mode 1, the host CPU **12** accesses and changes the image data stored in RAM **16** as required by a software application executing on the host CPU **12** of the mobile electronic device. After receiving a signal from the CPU interface **14**, the display controller **20** retrieves a row of image data via the MUX **26** (which connects the display controller **20** to the display RAM **16** in mode 1) and transmits a row of the image data to the segment driver **30**. After determining the location on the panel for the image data and receiving a pulse from the common driver **28**, the segment driver **30** then transmits the row of image data to the OLED panel **34**. This process is repeated for each row of the image and continues to be repeated to maintain the image on the OLED panel **34**. Once the image has been displayed on the panel, the CPU interface **14** initiates the screen saver down counter **46** by transmitting a signal to the load input **54d** of the screen saver down counter **46**. This value is loaded into the screen saver down counter **46** any time there is activity on the CPU interface **14** or if a row of image

data from the display RAM **16** is transmitted to the OLED panel **34**. This value is decremented after each clock pulse and if the value is decremented to zero, the mobile electronic device and the display panel enter the screen saver mode.

**[0025]** Turning to Figure 3, a flow diagram of a method of providing a screen saver for a mobile electronic device is shown. Firstly, a check is performed to determine if there is any CPU interface activity. For example, when a WRITE line toggles, the screen saver down counter **46** is reloaded. The screen saver down counter **46** decrements with every pulse of the clock signal **50** from the CPU interface **14**. As long as the screen saver down counter **46** has not reached zero and CPU activity is sensed, the mobile electronic device remains in mode 1. When the screen saver down counter **46** reaches zero, it is detected at step **102** that the screen saver time out has elapsed. In this event, there has not been any activity on the CPU interface during the allotted time period and the screen saver down counter **46** has not been reloaded, indicating a need to change from the operating mode to the screen saver mode. The screen saver down counter **46** then sends a signal via its zero output **58d** to the MUX **26** to switch the connection for the display controller **20** from the display RAM **16** to the screen saver RAM **18** so that the display controller **20** retrieves the image data from the screen saver RAM **18** (step **104**). The signal from the zero output **58d** is also transmitted to the command generator **53** to generate its two commands.

**[0026]** In mode 2, the image on the display **34** is preferably black, or not powered except for the small image area. The image data is stored in the screen saver RAM **18**. The image data is retrieved from the screen saver RAM **18** (step **106**) by the display controller **20** and the display location for the screen saver image is also determined by the display controller **20** (step **108**) via the command generator **53** and displayed on the panel **34** (step **110**) as described above with respect to the display RAM **16**. The displayed location of the screen saver image is not fixed and randomly (or in accordance with pre-defined movements) moves around the panel as defined by the command generator **53** and the move icon down counter **48**. The movement of the screen saver image allows the primary colours of the OLED panel **34** to age uniformly. In addition to the screen saver image moving, in a preferred embodiment, the colour of the screen saver image changes at

a rate defined by the RGB timers **35**. These timers **35** are programmed to match the life of the three primary colours of the OLED panel.

**[0027]** Once the move icon down counter **48** is enabled, the start address of the screen saver image changes every time the move icon down counter **48** reaches zero. The counter is initially set by the input **90** from the host CPU **12** via the CPU interface **14** and decremented with each clock pulse when the mobile electronic device and display panel are in the screen saver mode. When the move icon down counter **48** reaches zero, the move icon timer has elapsed (step **112**), and a signal is transmitted from the zero output **58e** of the move icon down counter **48** to the command generator **53** which generates a new address for the image to be displayed on the OLED panel **34**. This new address is then transmitted to the display controller **20** and the screen saver image is retrieved (step **106**). If the move icon timer has not elapsed, a check is performed to verify that the colour aging is enabled (step **114**). If not, a check is then performed to verify CPU interface activity (step **100**). In the absence of interface activity, steps **112**, **106-110** if necessary, and **114** are repeated. Where interface activity is detected, screen saver mode is exited, as shown at **101**.

**[0028]** If colour aging is enabled, all the DACS are turned off (step **115**) until the RED, GREEN and BLUE down counters **38**, **42**, and **45** are loaded and enabled. The RED, GREEN and BLUE down counters **38**, **42**, and **45** are then used to control the relative aging factor for these panel colours. In a preferred embodiment, the RED DAC and the RED counter **38** are enabled (step **116**) by inputs **70** and **90** from the host CPU and the ORing of the zero signal **58d** from the screen saver down counter **46** and the zero signal **58c** from the BLUE down counter **45**. When the RED down counter **38** reaches zero, a signal from its zero output **58a** is transmitted to an AND gate along with the input **70** from the CPU interface **14** and the signal from the zero output **58d** of the screen saver down counter **46**, and the RED DAC disable signal **62** disables the RED DAC (step **118**). The signal from the zero output **58a** is also transmitted to the enable input **56b** of the GREEN down counter **42** to enable the GREEN DAC and the GREEN timer (step **120**). When the GREEN down counter **42** decrements to zero, a signal from its zero output **58b** is transmitted to an AND gate along with the input **70** from the CPU interface **14** and the signal from the zero output of the screen saver down counter **46**, and the GREEN DAC

disable signal **64** disables the GREEN DAC (step **122**). The signal from the zero output **58b** is also transmitted to the enable input **56b** of the BLUE down counter **45** to enable the BLUE DAC and the BLUE timer (step **124**). Once the BLUE down counter decrements to zero, a signal from its zero output **58c** is transmitted to an AND gate along with the input **70** from the CPU interface **14** and the signal from the zero output of the screen saver down counter **46**, and the BLUE DAC disable signal **66** disables the BLUE DAC (step **126**). The signal from the zero output **58c** is also transmitted to the OR gate and coupled with the signal from the zero output **58d** of the screen saver down counter **46**. The result of this ORing is then transmitted to the load input **54a** of the RED down counter **38**. This process continues until the CPU interface re-loads the screen saver down counter **46** via the load signal **54d**, which results in the screen saver down counter **46** and the zero output **58d** being asserted, which enables all three DACs.

**[0029]** As will be understood, there are many different implementations and methods for driving an OLED panel **34**. Other OLED drivers may use external RAM or have a common and segment IC as a separate component. Furthermore, in other embodiments, the screen saver controller may be included within the display controller **20**.

**[0030]** It will also be understood that although step 100 is shown as a separate step that follows other steps in the method shown in Fig. 3, interface activity preferably interrupts a screen saver mode, such that screen save mode is exited upon detection of activity.

**[0031]** In another embodiment of the invention, data, such as the time data, system status data or the number of unread email data, may be displayed in the screen saver image

**[0032]** The above-described embodiments of the present invention are intended to be examples only. Alterations, modifications and variations may be effected to the particular embodiments by those of skill in the art without departing from the scope of the invention, which is defined solely by the claims appended hereto.